Mid-infrared supercontinuum generation in chalcogenide step-index fibers pumped at 2.9 and 4.5μm

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The Mid-InfraRed (MIR) spectral range (2-12µm) contains the spectral fingerprint of many organic molecules, which can be probed nondestructively for e.g. detection of skin cancer. For this SuperContinuum (SC) laser sources are good candidates since they can have broadband bandwidths together with high spectral densities. Here we consider a MIR SC laser sources based on chalcogenide step-index fibers with exceptionally high numerical aperture of ~1 pumped either with Er:ZBLAN and Pr:CHALC fiber laser operating at 2.9 and 4.5µm, respectively, having P0=1kW, T0=50ps, $\nu_R = 4MHz$ and P_{avg}=200mW.

The optical properties of fibers (dispersion, nonlinearity and confinement loss) are modeled using the finite element tools based on measured refractive indices of the core and the cladding chalcogenide compositions.

Generation of MIR SC is investigated using the Generalized Nonlinear Schrödinger Equation using actual measured fiber loss obtained using FTIR spectrometry. Pumping the fiber at 2.9µm and 4.5µm yields a SC spanning the 3-10 and 3-12.5µm range with around 10 and 20mW converted into the 8-10µm band, respectively.

Using specially designed CHALC SIF in conjunction with pulsed MIR fiber lasers at 2.9 and 4.5µm it is thus possible to generate a MIR SC spanning almost the entire spectral region of interest with ample power being converted into the MIR.

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